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Lakehurst, New Jersey
08733

E-28 ARRESTING-GEAR DECK-PENDANT ROLLOVER TESTS WITH THE F-4 AIRCRAFT (3 April to 14 July 1970)

Final Report
25 August 1971

by

Waldemar Wastallo
Recovery Division

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Prepared under Naval Air Systems Command
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13. ABSTRACT

E-28 arresting-gear deck-pendant rollover tests were conducted with the F-4 aircraft to investigate the dislodgement of a MK 77 Mod 2 fire bomb store from the centerline station of an F-4B aircraft and to provide information for development of an improved pendant support for the E-28 arresting gear. Deck-pendant rollovers were conducted with aircraft-tire-section, plastic-rail, and rubber-donut pendant supports and without supports.

The pendant heights caused by nosewheel rollovers of aircraft-tire-section and plastic-rail pendant supports exceeded the 8-inch minimum runway clearance of the aircraft's centerline station store; clearances were marginal using rubber-donut supports. The runway clearance of the store was also exceeded after main-wheel rollovers of the pendant supported with aircraft tire sections, plastic rails, or rubber donuts. Pendant heights caused by nosewheel rollover were not significantly affected by aircraft rollover speed or deck pendant pre-tension, but were increased significantly by direct nosewheel rollover of the support. When installed without supports, the pendant remained on the runway surface during F-4 aircraft rollovers at afterburner power.

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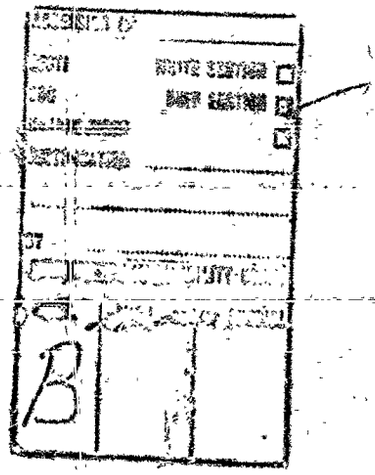

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Emergency Arresting Gear						
E-28 Arresting Gear						
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Deck Pendant Rollover						
Pendant Supports						

NAVAL AIR TEST FACILITY
NAVAL AIR STATION
LAKEHURST, NEW JERSEY
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ABSTRACT

E-28 arresting-gear deck-pendant rollover tests were conducted with the F-4 aircraft to investigate the dislodgement of a MK 77 Mod 2 fire bomb store from the centerline station of an F-4B aircraft and to provide information for development of an improved pendant support for the E-28 arresting gear. Deck - pendant rollovers were conducted with aircraft-tire-section, plastic-rail, and rubber-donut pendant supports and without supports.

The pendant heights caused by nosewheel rollovers of aircraft-tire-section and plastic-rail pendant supports exceeded the 8-inch minimum runway clearance of the aircraft's centerline station store; clearances were marginal using rubber-donut supports. The runway clearance of the store was also exceeded after main-wheel rollovers of the pendant supported with aircraft tire sections, plastic rails, or rubber donuts. Pendant heights caused by nosewheel rollover were not significantly affected by aircraft rollover speed or deck pendant pre-tension, but were increased significantly by direct nosewheel rollover of the support. When installed without supports, the pendant remained on the runway surface during F-4 aircraft rollovers at afterburner power.

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I INTRODUCTION

A. An operating air base has reported three accidents in which the MK 77 Mod 2 fire bomb store carried at the centerline station of an F-4B aircraft was engaged and dislodged by the deck pendant of an E-28 arresting gear. The accidents occurred as the aircraft rolled over the deck pendant at a speed of approximately 80 knots during the initial portion of the takeoff roll. Aircraft tire sections were installed to support the pre-tensioned pendant of the arresting gear in battery position. Incidents of pendant contact with the bottom of the store have also occurred with the plastic-rail type support. The nose of the centerline station store is located 17 inches forward and/or 5 inches aft of the main landing gear when installed at the forward (recommended) or the aft centerline station positions. With proper main-landing-gear strut and tire pressures, the minimum runway clearance is 8 inches to the bottom and 18 inches to the nose/centerline of the 90-inch-long store.

B. This test program was initiated as a consequence of the above accidents. The program consisted of F-4 aircraft rollovers of the E-28 arresting-gear deck pendant and an F-4 airframe rollover of a simulated E-28 arresting-gear deck-pendant installation. The tests were authorized by reference (a) and were conducted at the RALS (Runway Arrested Landing Site) and the RSTS (Recovery Systems Track Site) No. 5 from 3 April to 14 July 1970. The test objectives were to:

1. Investigate the centerline station store damage problem.

2. Determine the effects of aircraft wheel rollover and engine afterburner blast on the pendant installed on the arresting gear without supports.

3. Evaluate the effects of plastic-rail and rubber-donut supports, pendant pre-tension, aircraft rollover speed, and the lateral distance between the nosewheel and support on peak pendant heights after nosewheel and main-wheel rollovers.

C. The results of the deck-pendant rollover tests are presented and evaluated in this report. Pendant height profiles are plotted to illustrate the interference problem with the centerline station store, and peak pendant heights after nosewheel and main-wheel rollover are plotted to show the effects of each of the selected variables. All test objectives were accomplished.

II TEST EQUIPMENT

A. RALS

1. The E-28 arresting gear (units 019 and 020) was configured as specified in NAEC Drawing 6137164 and as follows:

a. Deck-sheave span - 225 feet

b. Arresting-gear centerline - ON-CENTER on 200-foot-wide runway

c. Tape-reel-to-deck-sheave-split distance - 17 feet

d. Uncoated nylon purchase tapes - 920 feet long x 8 inches wide x 0.35 inch thick

e. Nonrotating wire-rope deck pendants - 190 feet long x 1-1/4 inches in diameter (used with aircraft-tire-section and plastic-rail supports) and 135 feet long x 1-1/4 inches in diameter (used with rubber-donut supports)

f. Pendant supports were installed as follows (the various supports are shown in Figure 1):

Refer to Figure No.	Pendant Support				Pendant Height on Support (Inches)*
	Type	Identifying Number	No. Used	Locations from the Runway Centerline, Port and Starboard (Feet)	
1A	Aircraft tire section	NAVAIR 51-5-31	4	6 and 18† 10 and 30‡ 7 and 21	5-3/8
1B	Rubber donut	NAEC EO 68-776	6	7, 21 and 35	4-1/8
1C	Plastic rail	NAEC PN 613572-6	4	7 and 21	4-1/2

* Measured to the top surface of the pendant in battery position.
† Site events 26,629, 26,630, and 26,631.
‡ Site event 26,632.

2. The gross-weight of the F-4 aircraft ranged from 30,900 to 38,000 pounds. External stores were not installed.

B. RSTS No. 5

1. The deck pendant of the E-28 arresting gear was simulated by the installation of a 90-foot-long x 1-1/4-inch-diameter nonrotating wire-rope deck pendant. The pendant was installed and pre-tensioned in battery position between two short lengths of E-28 purchase tape which were anchored to the universal mounting pad at each end with a turnbuckle. An E-28 tape connector and an M-21 tape clamp were used to fasten the pendant and turnbuckle end of each tape.

2. Aircraft-tire-section pendant supports, NAVAIR 51-5-31, were installed ON-CENTER and 14 feet to port and starboard of the centerline.

3. The gross weight of the F-4 airframe was 35,000 pounds. External stores were not installed.

III TEST PROCEDURE

A. RALS

1. Rollover tests of the E-28 arresting-gear deck pendant were conducted with the F-4 aircraft. The deck pendant of the arresting gear was configured with either aircraft-tire-section, plastic-rail, or rubber-donut supports and was also placed on the runway surface without supports. Pendant pre-tension, aircraft speed, and nosewheel lateral distance from the support at pendant rollover were varied. The procedure was as follows:

a. The initial tests using aircraft-tire-section pendant supports were conducted to investigate possible causes for an accident with the F-4B aircraft store. The nosewheel-to-support lateral distance at rollover was varied from 10 to 2 feet and the rollover speed from 80 to 138 knots. Direct nosewheel rollover of a support was purposely avoided because engagement of the main landing gear strut by the deck pendant of the arresting gear was thought to be possible. It was decided to test the suspect support rollover condition at RSTS No. 5 with the F-4 airframe rather than risk damaging the F-4 aircraft.

b. A series of tests was conducted at speeds ranging from 82 to 157 knots with the engines of the F-4 aircraft at afterburner power during rollover to determine the effects of wheel impact and afterburner blast on a deck pendant placed on the runway surface without supports. Pendant pre-tension was varied from 1,160 to 0 pounds.

c. The final test series was conducted from slow taxi speed to a maximum speed of 144 knots to evaluate the effects of the five parameters on peak pendant heights after nosewheel and main-wheel rollover. The pendant-store contact problem with the plastic-rail type support was also investigated. The nosewheel-to-support (plastic rail and rubber donut) lateral distances at rollover were 7, 2, and 0 feet. Pendant pre-tension was varied from 2,360 to 0 pounds. Because of other test commitments, the F-4 aircraft was not available to complete the scheduled 140-knot rollover of the plastic-rail support.

2. Aircraft and arresting-gear instrumentation is listed as follows:

Parameter	Recording Method	Estimated Accuracy Within (±)
Aircraft speed	Deck Coil	2 knots
Aircraft weight (basic and fuel)	Electronic load cells and aircraft fuel quantity gage	200 pounds
Pendant tension	Strain-gaged link	5%
Aircraft nosewheel position	Visual observation and aircraft-mounted high-speed motion-picture camera	6 inches
Pendant height above runway surface*	Ground-based high-speed motion-picture cameras†	1 inch

* Measurements refer to top surface of pendant.

† Located 40 feet to port and starboard of runway centerline, 18 inches above the runway surface and 160 feet downstream from arresting-gear deck pendant. A third camera was located directly behind the port arresting-gear unit in the vertical plane of the deck pendant.

Pendant heights were measured by means of five 2-foot-high portable stakes painted with alternate 2-inch-wide horizontal black and white stripes. The stakes were photographed alongside the deck pendant as shown in Figure 2 prior to each series of rollovers to provide a calibration grid for use on a BOSCAR film reader.

B. RSTS No. 5

1. A rollover test of a simulated E-28 arresting-gear deck-pendant installation was conducted at a speed of 99 knots. Three aircraft-tire-section pendant supports were installed so the F-4 airframe nosewheel rolled directly over the ON-CENTER support. A triple barricade installed on the Mark 7 Mod 3 arresting gear for other project tests was used to arrest the F-4 airframe.

2. The instrumentation was similar to that used at RALS.

IV PRESENTATION OF TEST RESULTS

A. During this test program, a total of 76 deck-pendant rollovers were conducted: 75 rollovers of the E-28 arresting-gear deck pendant at RALS with the F-4 aircraft and one rollover of a simulated E-28 deck-pendant installation at RSTS No. 5 with the F-4 airframe. The tabulated data of each test event are contained in Appendix A and summarized in the following table:

No. of Events	F-4 Aircraft Weight Range (1,000 Lb)	F-4 Aircraft Speed Range (Kn)	Pendant Support Type	Pendant Support Span (Ft)	Nosewheel Distance From the Support (Ft)	Range of Peak Pendant Heights After Rollover (In.) Nosewheel	Range of Peak Pendant Heights After Rollover (In.) Main Wheel
1	38.0	132	Tires	12	6	*	10.3
2	36.0-37.0	137-138	"	"	3	*	10.5-11.5
1	35.0	133	"	20	10	*	9.3
2	36.4-38.5	80- 82	"	14	3	6.0-7.4	6.7- 7.6
2	34.9-35.3	80- 82	"	"	2	6.6-7.2	9.0- 9.3
1†	35.0	99	"	"	0	12.1	22.3
11	30.9-36.4	82-157	None	None	‡	‡	‡
5	36.2-38.2	99-139	Rails	14	7	3.9-6.0	7.1- 9.3
14	33.4-37.8	81-142	"	"	2	5.4-7.7	8.3-11.1
15	38.2⊕-31.4♦	Taxi-128	"	"	0	4.5-9.9	8.3-19.4
4	33.2-38.0	99-138	Donuts	"	7	3.6-5.0	6.4- 8.9
5	32.4-37.4	101-144	"	"	2	3.5-4.9	5.5- 7.9
13	32.9-37.7	68-141	"	"	0	5.3-7.7	6.0-10.2

* No record obtained.

† F-4 airframe at RSTS No. 5. Six feet of tape pulled through port M-21 tape clamp.

‡ Pendant moved aft on runway surface by afterburner blast: no vertical motion.

⊕ Cam mechanism of port or starboard arresting engine released pendant pre-tension during 91-, 99-, 102-, and 128-knot rollovers.

♦ Cam mechanism of both port and starboard arresting engines released pendant pre-tension during 87-knot rollover.

B. The pendant height profile beneath the centerline of the F-4 airframe/aircraft during rollovers of the pendant are shown in Figures 3, 4, and 5 to illustrate the interference problem with the centerline station store. Figure 3 shows the results of an F-4 airframe nosewheel rollover of an aircraft-tire-section pendant support at a speed of 99 knots. Figures 4 and 5 show typical

pendant height profiles during F-4 aircraft rollovers of the plastic-rail and rubber-donut supported pendants, respectively, at speeds of 82 to 139 knots and lateral distances of 0 and 7 feet between the nosewheel and support at rollover. The abscissa of Figures 3, 4, and 5, Aircraft Travel (Feet), corresponds to the following locations on the F-4 aircraft:

Aircraft Travel (Feet)	Location
0	Initial nosewheel contact with the deck pendant
21.9-29.3	Forward centerline station store
23.2	Main landing gear
23.7-31.2	Aft centerline station store
40.8	Arresting-hook point on the static ground line

Minimum runway clearance is 8 inches to the bottom and 18 inches to the nose/centerline of the 90-inch-long centerline station store. The F-4 aircraft main-wheel span is 17 feet 11 inches.

C. Figures 6 and 7 show the peak pendant heights caused by the nosewheel and the main wheels of the F-4 aircraft during rollovers of the pendant supported by plastic rails and rubber donuts. The peak pendant heights are identified by symbols according to the lateral distance between the nosewheel and the support at rollover and are plotted versus rollover speed and pendant pre-tension to show the general effects of these variables. Only the general effects are considered in the analysis because of the limited quantity of the data sample and extent of the data scatter. To aid in the analysis, the least squares method was used to reduce the individual data points to best-fit curves. The assumed form of the equation is:

$$\text{Pendant height} = aV^b$$

where V is the rollover speed or pendant pre-tension variable

and a and b are constants determined from the test data using the least squares method.

Aircraft-tire-section peak pendant height data is listed in Appendix A; this data was not plotted because it includes several differing test parameters within the small size data sample.

V TEST RESULTS AND DISCUSSION

A. Pendant Height Profiles

1. Aircraft-Tire-Section Supports: A maximum pendant height profile was realized during direct nosewheel rollover of the aircraft-tire-section support (see Figure 3). The height of the pendant exceeded the 8-inch minimum runway clearance of the store at the centerline station location of the F-4 aircraft. After this result, no additional tests with aircraft-tire-section supports were conducted. A photographic sequence of the rollover is shown in Figure 8.

2. Plastic-Rail Supports: The 8-inch minimum runway clearance of the store was exceeded forward of or at the centerline station location of the F-4 aircraft (see Figure 4, graphs B, C, D, and E).

3. Rubber-Donut Supports: The 8-inch minimum runway clearance of the store was not exceeded (see Figure 5); however, the margin of safety indicated in Figure 5, graphs C and E, is only 1/2 to 1 inch.

B. Peak Pendant Heights

1. Nosewheel rollover peak pendant heights at nosewheel-to-support distances of 0, 2, and 7 feet were not significantly affected by either rollover speed or pendant pre-tension (see Figures 6 and 7). The highest peak values of 7.7 and 9.9 inches occurred as a result of direct nosewheel rollovers of the rubber-donut and the plastic-rail supports, respectively; the minimum values occurred at nosewheel-to-support lateral distances of 2 or 7 feet from the rubber-donut support and 7 feet from the plastic-rail support.

2. The 8-inch minimum runway clearance of the centerline station store was/was not exceeded as follows:

a. Was exceeded during 9 of the 14 direct nosewheel rollovers of the plastic-rail support but was not exceeded during 13 direct nosewheel rollovers of the donut support.

b. Was exceeded during 30 of the 32 main-wheel rollovers of the plastic-rail-supported pendant and during 10 of the 22 main-wheel rollovers of the donut-supported pendant.

3. Main-wheel rollovers produced higher peak pendant heights and greater pendant height scatter than nosewheel rollovers. The dissimilar characteristics of the main-wheel rollover peak pendant height curves reflect the extent of the data scatter (see Figures 6 and 7).

C. Rollover of Unsupported Pendant: Although nosewheel and main-wheel rollover impacts caused the unsupported pendant to roll slightly, the pendant remained on the runway surface at all times. The portion of the pendant in the direct path of the afterburner blast moved 2 to 6 feet when not pre-tensioned and from 0 to 2 feet when pre-tensioned to 1,000 and 600 pounds. The rollover conditions for these events are listed in Appendix A.

D. Arresting-Gear and Aircraft Operation

1. The cam mechanism of either one or both arresting engines released pendant pre-tension during 5 of the 14 direct nosewheel rollovers of the plastic-rail supports. It is probable that the main wheels actually caused the cams to release because the main-wheel rollover impact loads generated in the pendant exceeded the cam release setting during these events.

2. The F-4 aircraft nosewheel tire and plastic-rail pendant support in Figure 9 show evidence of distortion due to lateral loads at the common area of contact during nosewheel rollover of the support. Several anchor screws were pulled through enlarged holes within the metal baseplate of the support. Permanent distortion of the plastic rail made realignment of the holes with the expansion anchors in the runway and replacement of the screws difficult. The nose and main landing gear of the F-4 aircraft were not damaged as a result of the rollovers.

VI CONCLUSIONS

A. These tests substantiate that the pendant will impact the MK 77 Mod 2 fire bomb installed at the centerline station of the F-4 aircraft (8-inch minimum runway clearance) if aircraft-tire-section or plastic-rail pendant supports are used; clearance is marginal if rubber-donut supports are used. Therefore, these pendant supports are unsatisfactory for use with the E-28 arresting gear. (Section V, paragraphs A1, A2, and A3)

B. The unsupported deck pendant of the E-28 arresting gear will remain on the runway surface with no vertical motion during F-4 aircraft rollovers at afterburner power. (Section V, paragraph C)

C. Rollover speed and deck-pendant pre-tension do not have a significant effect on peak pendant heights caused by rollover by the nosewheel. The effect of these variables on peak pendant heights caused by rollover by the main wheels is inconclusive. (Section V, paragraph B)

D. The highest peak pendant heights after nosewheel and main-wheel rollover occurred after direct rollover of the support by the nosewheel and subsequent pendant rollover by the main wheels. The pendant heights decreased as the lateral distance between the nosewheel and the support was increased. (Section V, paragraph B)

E. Main-wheel rollover pendant impact load is sufficient to actuate the cam mechanism of the arresting engine and release pendant pre-tension after nosewheel rollover of the plastic-rail support. (Section V, paragraph D1)

F. Direct wheel rollovers permanently distort the plastic-rail support and separate the anchor screws from the support baseplate. (Section V, paragraph D2)

G. The effect of the pendant battery-position heights listed in Section II, paragraph A1f, on the resulting pendant heights caused by aircraft wheel rollover was not determined.

VII RECOMMENDATIONS

A. Rail- and donut-type pendant supports should be developed to reduce pendant heights caused by aircraft wheel rollover. (In this regard, tests indicate the donut is superior to the rail support design.)

ß. Discontinue use of aircraft-tire-section pendant supports.

C. Until a suitable support is developed, the deck pendant of the E-28 arresting gear should be temporarily removed from the runway during takeoff of F-4 aircraft to prevent damage to the MK 77 Mod 2 fire bomb at the centerline station.

D. The rollover speed, pendant pre-tension, and nosewheel-to-support distance effects determined in these tests should be considered in the planning and the executing of future pendant-support development.

E. The release setting of the arresting-engine cam mechanism should be increased.

F. The plastic-rail support should be redesigned to reduce permanent distortion and improve support retention on the runway.

G. Determine the effect of pendant battery-position height on pendant heights caused by aircraft wheel rollover.

H. A warning block should be included in the F-4 aircraft NATOPS manual as follows:

WARNING

Do not roll over a supported deck pendant with the F-4 aircraft when configured with the MK 77 Mod 2 fire bomb at the centerline station.

NATF-EN-1113

VIII REFERENCE

(a) AIRTASK A5375373 2045 1537000043, WORK UNITS A5373B-23, -24

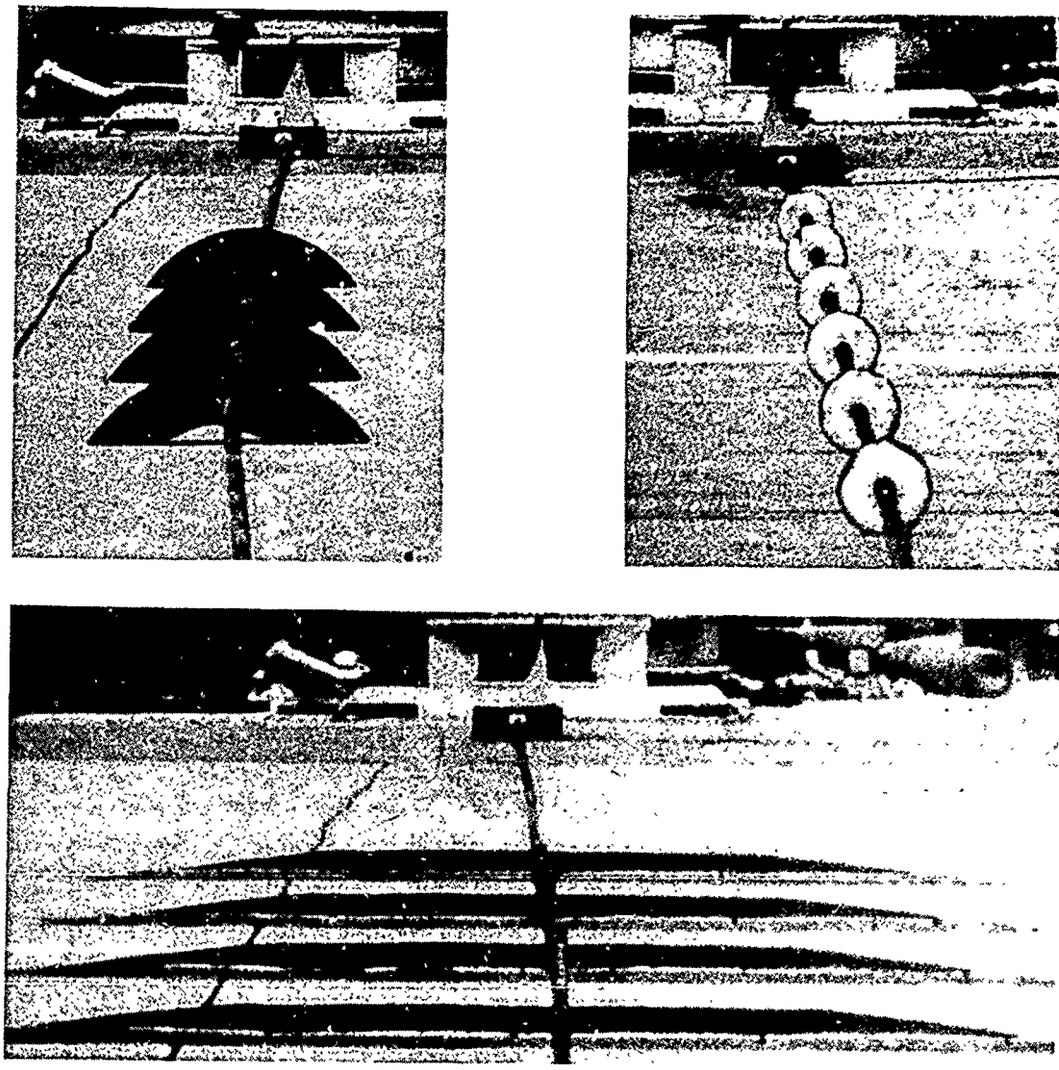


Figure 1 - Aircraft Tire Sections, Rubber Donuts, and Plastic Rails Installed to Support the E-28 Arresting-Gear Deck Pendant

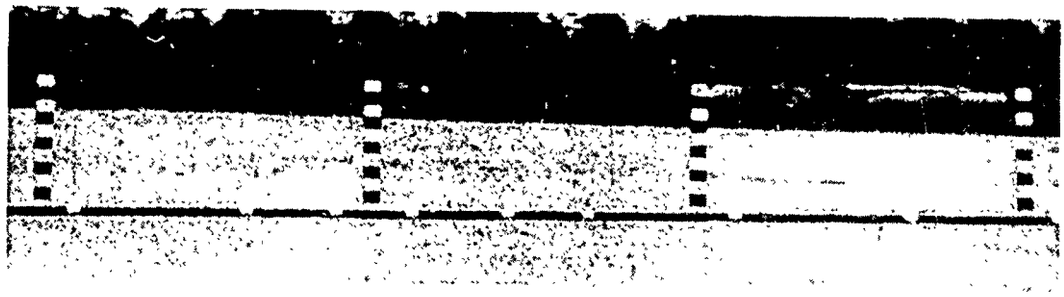
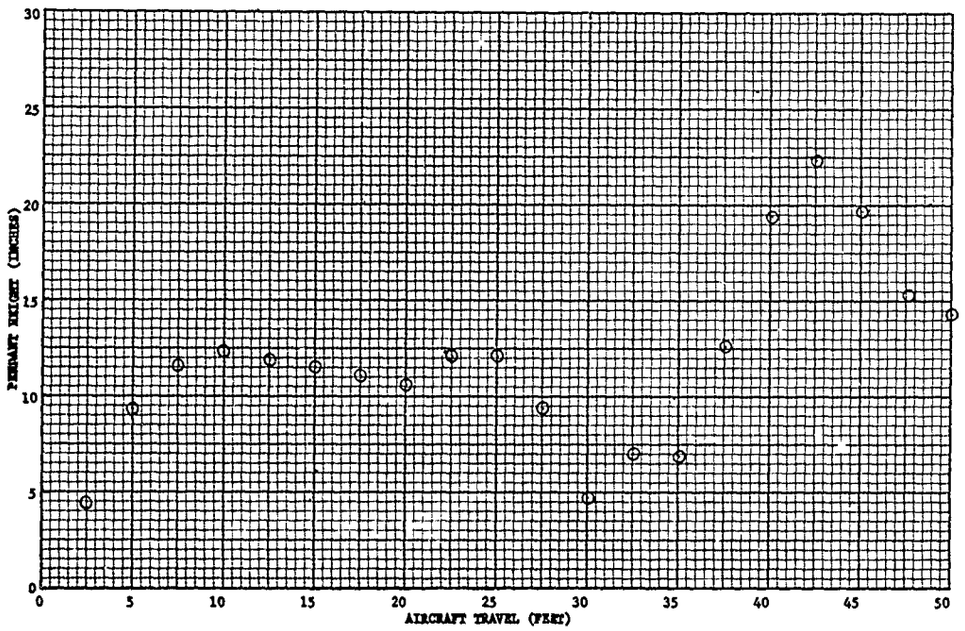


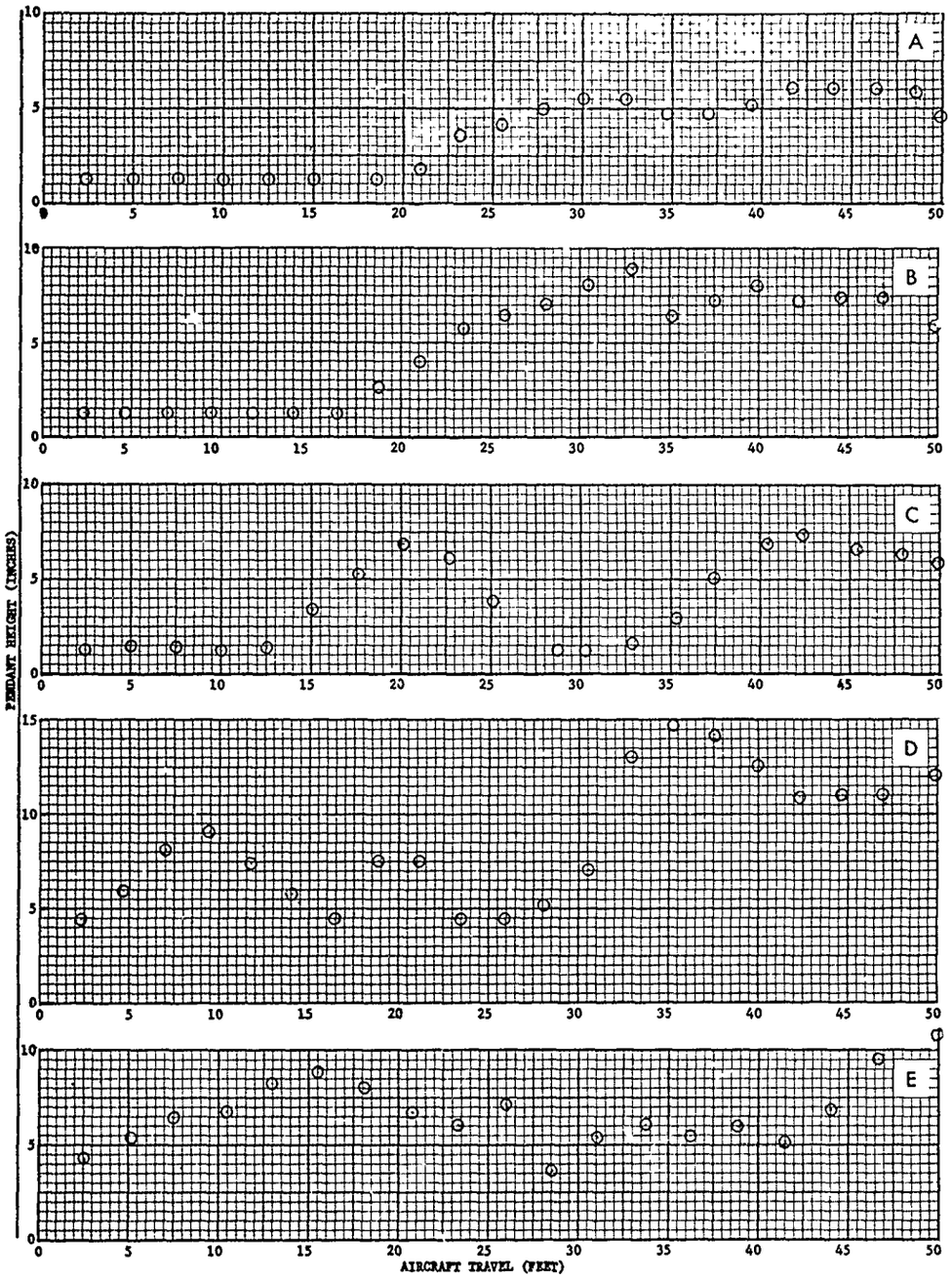
Figure 2 - E-28 Arresting-Gear Deck Pendant and 4 of 5 Portable Grid Stakes



KEY: EVENT NO.	ROLLOVER SPEED (KN)	DECK-PENDANT PRE-TENSION (LB)	LATERAL DISTANCE BETWEEN NOSEWHEEL AND SUPPORT (FT)
3,577*	99	440	0

* SIX FEET OF PURCHASE TAPE PULLED THROUGH THE PORT TAPE CLAMP.

Figure 3 - Pendant Height Profile at the F-4 Airframe Centerline During Rollover of the Simulated E-28 Arresting-Gear Deck Pendant at the NATF Recovery Systems Track Site No. 5 (Aircraft-Tire-Section Pendant Supports)

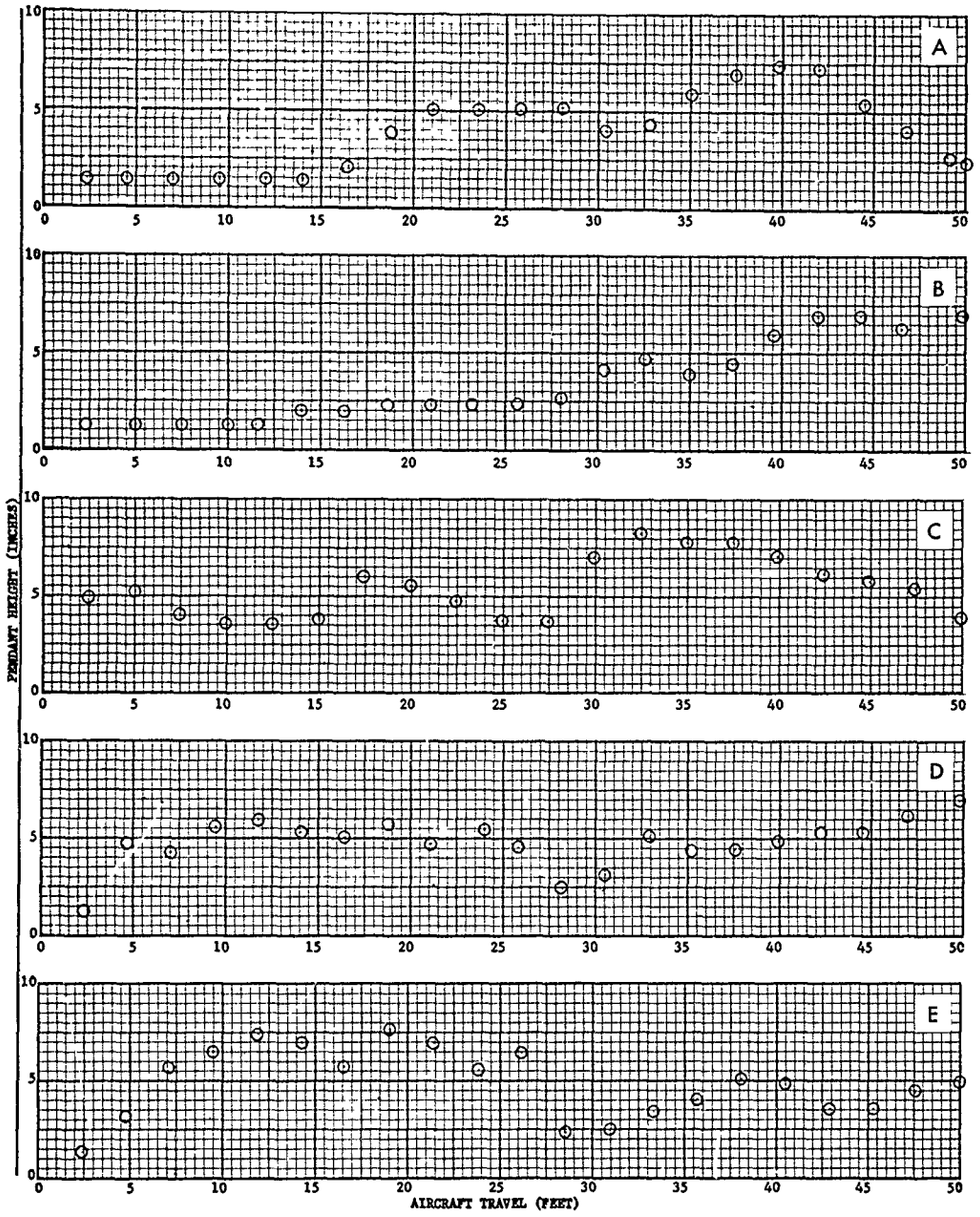


KEY:

GRAPH	EVENT NO.	ROLLOVER SPEED (KN)	DECK-PENDANT PRE-TENSION (LB)	LATERAL DISTANCE BETWEEN NOSEWHEEL AND SUPPORT (FT)
A	27,411	98	610	7
B	27,398	139	1,000	7
C	27,395	33	1,070	0
D	27,405*	87	890	0
E	27,436†	126	990	0

* PORT AND STARBOARD CAM MECHANISM RELEASED.
† STARBOARD CAM MECHANISM RELEASED.

Figure 4 - Pendant Height Profiles at the F-4 Aircraft Centerline During Rollovers of the E-28 Arresting-Gear Deck Pendant at the NATF Runway Arrested Landing Site (Plastic-Rail Pendant Supports)



KEY: GRAPH	EVENT NO.	ROLLOVER SPEED (KN)	DECK-PENDANT PRE-TENSION (LB)	LATERAL DISTANCE BETWEEN NOSEWHEEL AND SUPPORT (FT)
A	27,415	99	830	7
B	27,420	138	550	7
C	26,767	82	2,360	0
D	27,441	139	1,070	0
E	27,444	141	630	0

Figure 5 - Pendant Height Profiles at the F-4 Aircraft Centerline During Rollovers of the E-28 Arresting-Gear Deck Pendant at the NATF Runway Arrested Landing Site (Rubber-Donut Pendant Supports)

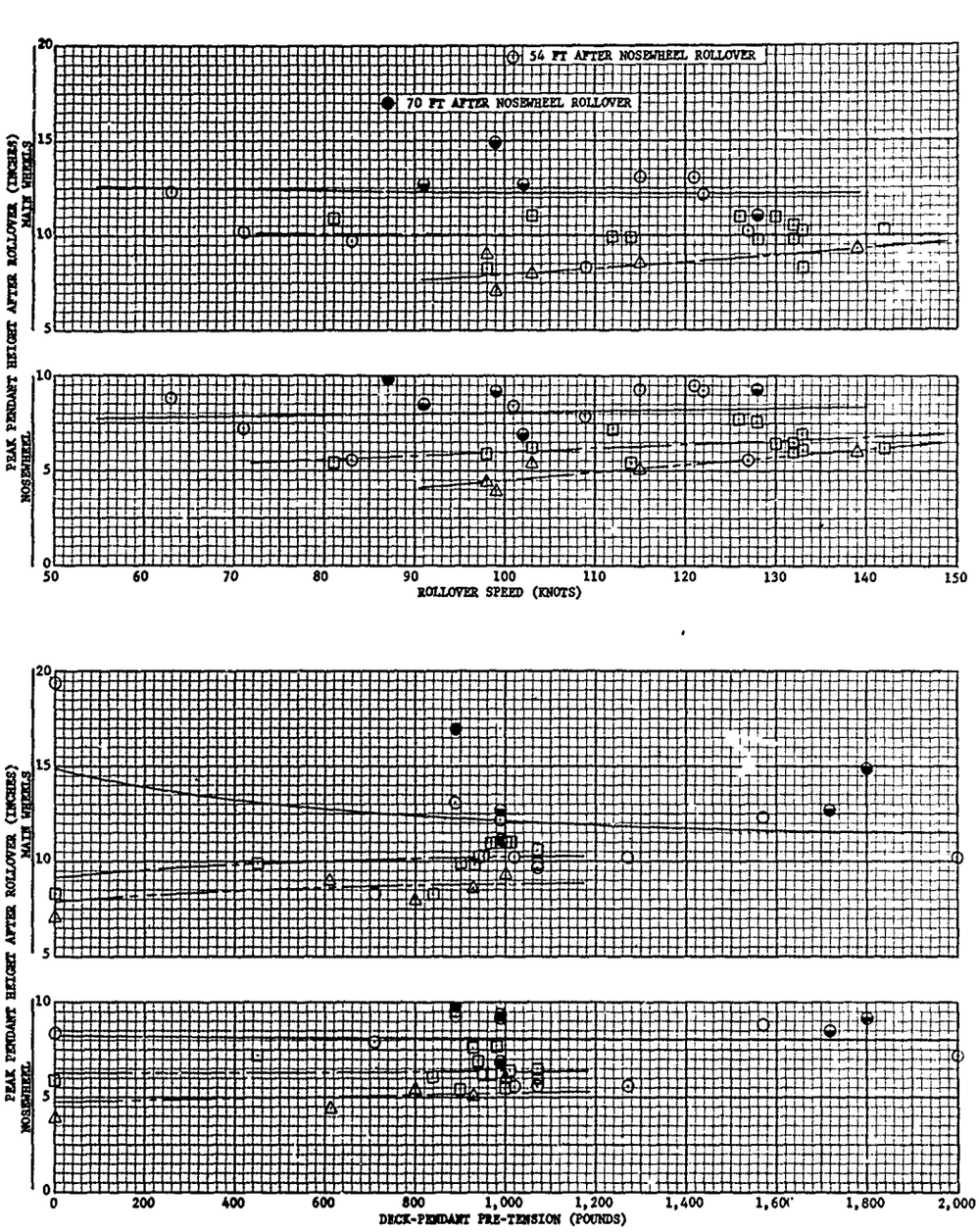


Figure 6 - Peak Deck-Pendant Heights After F-4 Aircraft Nosewheel and Main-Wheel Rollover versus Rollover Speed and Deck-Pendant Pre-tension (H-28 Arresting-Gear Deck Pendant With Plastic-Rail Type Supports)

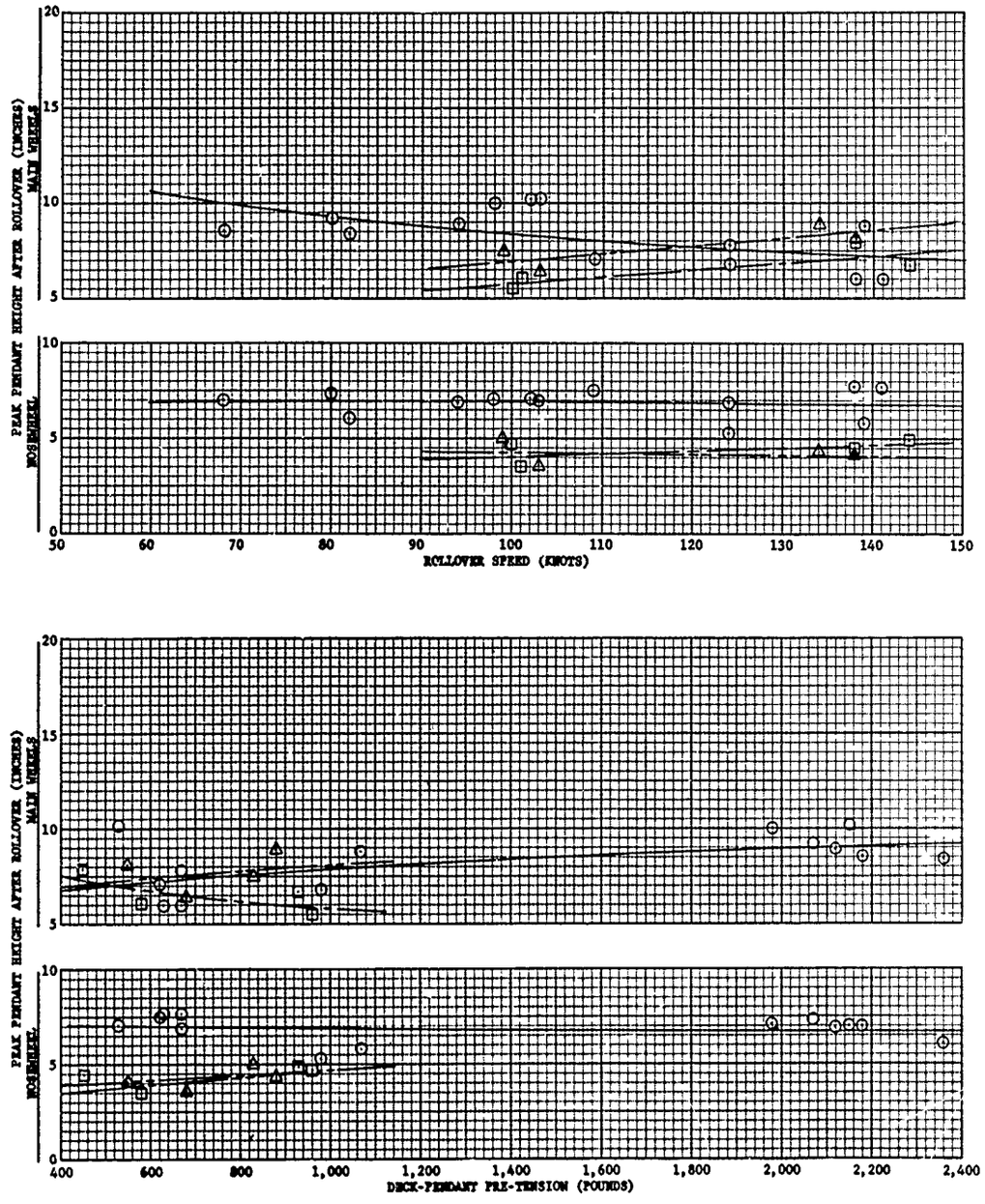


Figure 7 - Peak Deck-Pendant Heights After F-4 Aircraft Nosewheel and Main-Wheel Rollover versus Rollover Speed and Deck-Pendant Pre-tension
(H-28 Arresting-Gear Deck Pendant With Rubber-Donut Type Supports)

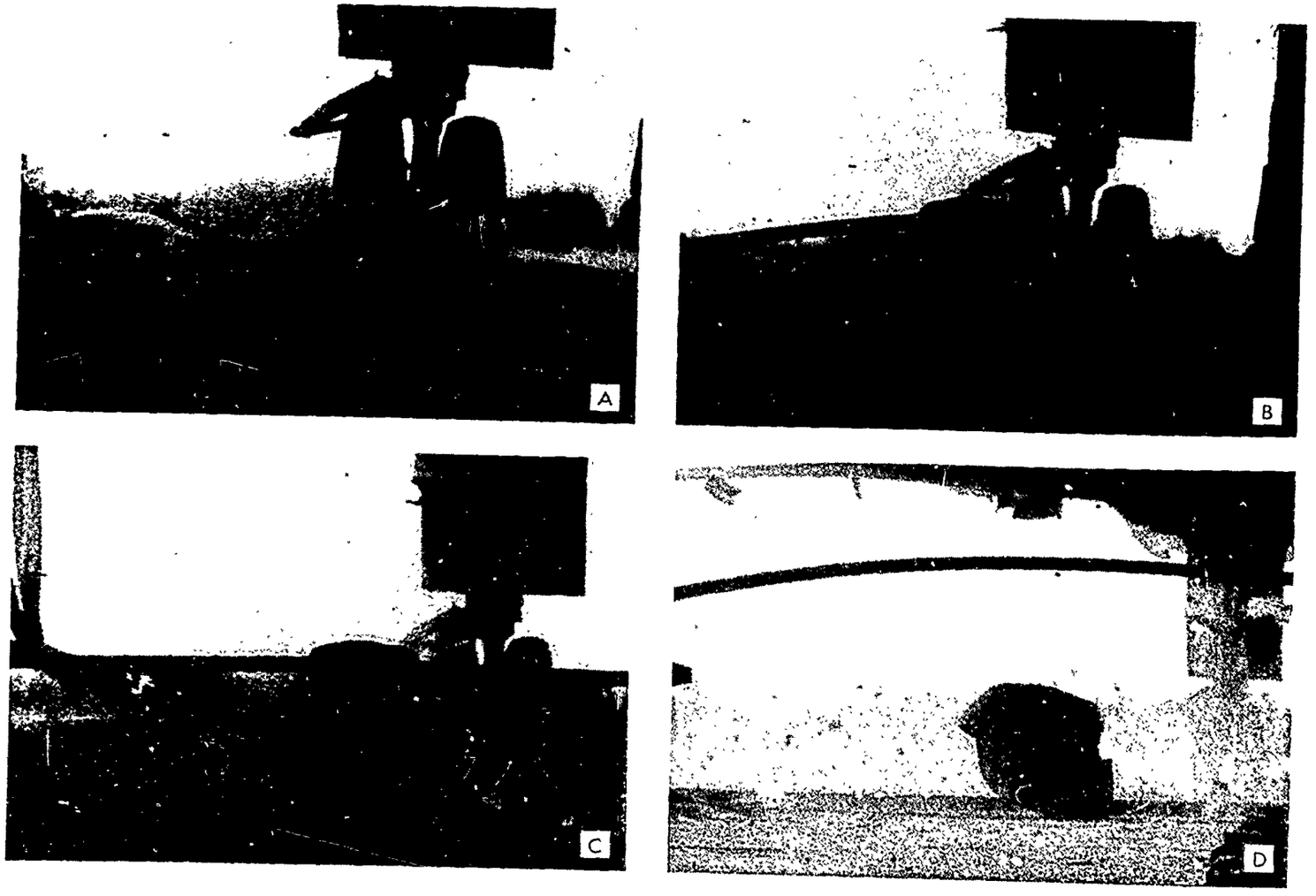


Figure 8 - Sequence Showing the Deck Pendant and the Aircraft-Tire-Section Pendant Support Immediately After Rollover by the F-4 Airframe Nosewheel

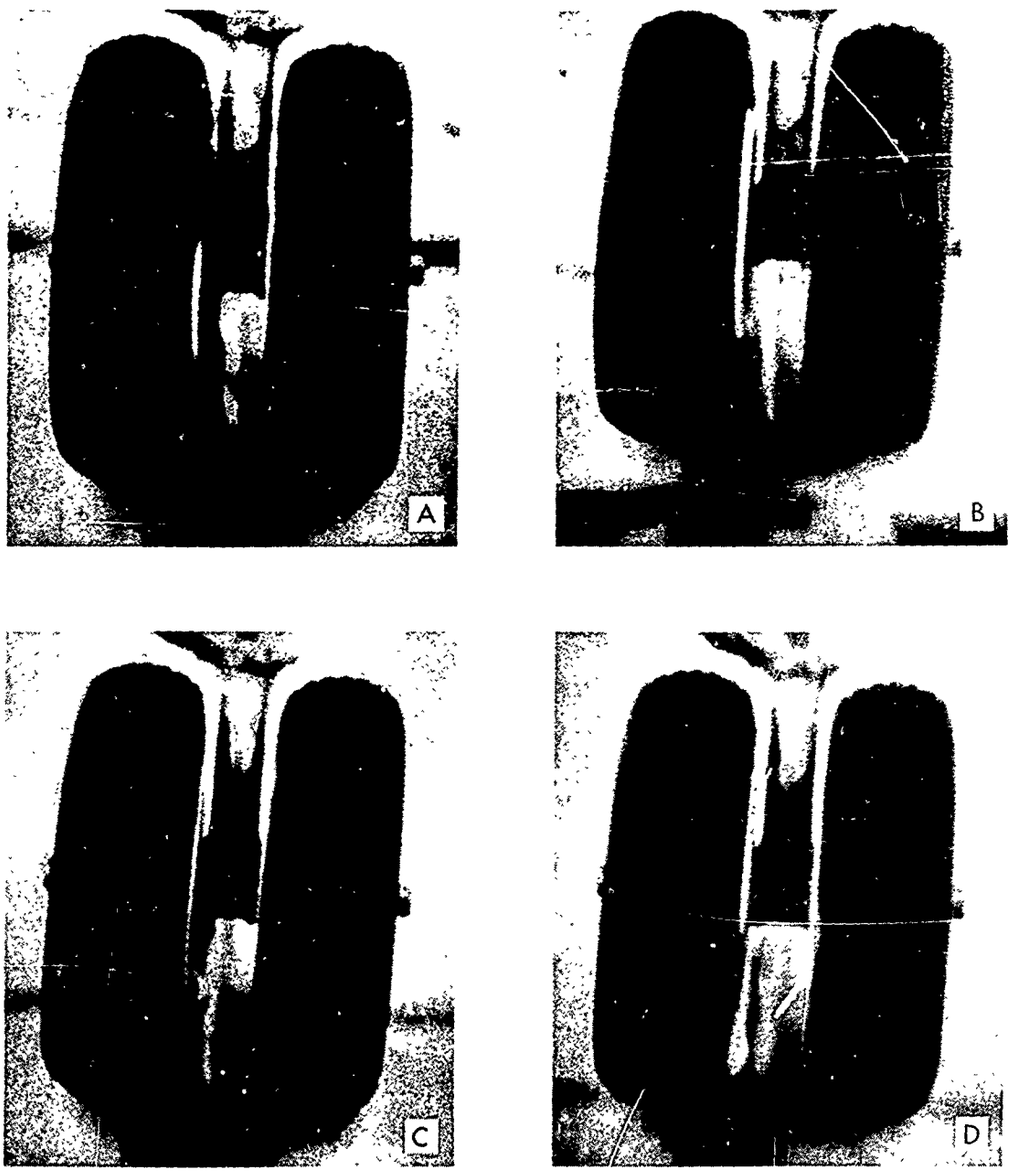


Figure 9 - Sequence Showing F-4 Aircraft Nosewheel Rollover of a Plastic-Rail Pendant Support

APPENDIX A - VERTICAL DATA SHEET FOR E-28 ARRESTING-GEAR DECK-PENDANT ROLLOVER TESTS WITH THE F-4 AIRCRAFT

Event No. Proi	Site (RALS)	1970 Date	F-4 Acft Weight (Lb)	Rollover Speed (Kn)	Rollover Nosewheel-to-Support Distance (Ft)	Pendant Support Positions, Port & Stbd, From Runway Centerline (Ft) Type*		Deck-Pendant Tension (Lb) Pre-tension	Nose-wheel Impact	Main-Wheel Impact	Final	Peak Pendant Height After Rollover (In.) Nose-wheel	Main Wheel
1	26,629	3 Apr	38,000	132	6	Tires	6 & 18	1,180	6,050	6,280	730	NR	10.3
2	26,630	"	37,000	137	3	"	"	820	5,730	5,730	640	NR	10.5
3	26,631	"	36,000	138	3	"	"	1,090	4,080	5,870	910	NR	11.5
4	26,632	"	35,000	133	10	"	10 & 30	900	5,340	6,030	870	NR	9.3
5	26,719	10 Apr	38,500	82	3	"	7 & 21	NR	NR	NR	NR	7.4	7.6
6	26,720	"	36,400	80	3	"	"	NR	NR	NR	NR	6.0	6.7
7	26,721	"	35,300	82	2	"	"	NR	NR	NR	NR	6.6	9.0
8	26,722	"	34,900	80	2	"	"	NR	NR	NR	NR	7.2	9.3
9	3,577†	"	35,000	99	0	"	0 & 14	440	3,660	11,200	0	12.1	22.3
10	26,760	1 May	37,700	Taxi	0	Rails	7 & 21	2,020	2,610	2,610	2,020	4.5	4.5
11	26,761	"	37,200	71	0	"	"	2,000	5,750	6,880	1,460	7.2	10.2
12	26,762	"	36,900	63	0	"	"	1,570	4,850	6,100	1,470	8.8	12.3
13	26,763‡	"	36,600	91	0	"	"	1,720	5,150	8,500	0	8.5	12.7
14	26,764‡	"	36,200	99	0	"	"	1,800	5,890	11,000	0	9.2	14.9
15	26,765	"	37,700	68	0	Donuts	7, 21, & 35	2,180	4,070	5,710	2,030	7.0	8.6
16	26,766	"	37,400	80	0	"	"	2,070	4,180	5,610	1,920	7.3	9.2
17	26,767	"	36,900	82	0	"	"	2,360	4,870	6,100	2,120	6.1	8.4
18	26,768	"	36,800	103	0	"	"	2,150	4,290	7,320	2,050	7.0	10.2
19	2o,769	"	35,800	98	0	"	"	1,980	4,710	7,440	1,930	7.1	10.0
20	26,770	"	35,400	94	0	"	"	2,120	3,980	6,540	1,770	6.9	8.9
21	26,771◇	5 May	36,400	132	NA	None	NA	770	1,450	970	1,110	•	•
22	26,772◇	"	35,500	103	NA	"	NA	970	1,450	1,320	1,220	•	•
23	26,773◇	"	35,100	128	NA	"	NA	1,160	1,700	1,400	1,360	•	•
24	26,774◇	"	34,100	115	NA	"	NA	630	1,120	820	1,160	•	•
25	26,775▲	"	33,500	82	NA	"	NA	630	1,070	1,020	630	0	0
26	26,776◇	"	33,200	137	NA	"	NA	630	1,020	820	970	•	•
27	26,777◇	"	32,500	112	NA	"	NA	680	1,020	820	970	•	•
28	26,778◇	"	31,900	114	NA	"	NA	0	400	250	500	•	•
29	26,779◇	"	31,600	117	NA	"	NA	0	490	390	590	•	•
30	26,780◇	"	31,000	157	NA	"	NA	0	480	340	240	•	•
31	26,781◇	"	30,900	134	NA	"	NA	50	432	NR	580	•	•
32	27,395	2 Jun	38,200	83	0	Rails	7 & 21	1,070	3,670	3,950	790	5.6	9.7
33	27,396	"	37,700	103	7	"	"	800	6,880	6,920	610	5.4	8.0
34	27,397	"	37,000	115	7	"	"	930	4,230	3,960	930	5.1	8.6
35	27,398	"	36,200	139	7	"	"	1,000	4,820	4,640	960	6.0	9.3
36	27,399	"	35,000	81	2	"	"	1,000	4,230	5,640	960	5.4	10.9
37	27,400	"	34,500	103	2	"	"	970	4,750	7,800	880	6.2	11.1
38	27,401	"	33,800	114	2	"	"	900	4,650	6,810	860	5.4	9.9
39	27,402	"	33,400	142	2	"	"	950	4,830	4,420	950	6.2	10.3
40	27,403■	"	32,500	102	0	"	"	990	4,970	9,630	90	6.9	12.7
41	27,404	"	32,000	115	0	"	"	890	4,400	8,400	580	9.3	13.1
42	27,405●	"	31,400	87	0	"	"	890	4,220	8,670	40	9.9	17.6
43	27,411	3 Jun	38,200	98	7	"	"	610	2,760	3,860	480	4.4	9.0
44	27,412	"	37,800	100	2	"	"	530	3,240	5,210	480	NR	NR
45	27,413	"	36,700	99	7	"	"	0	440	1,400	0	3.9	7.1
46	27,414	"	36,100	98	2	"	"	0	700	1,400	0	6.0	8.3
47	27,415	"	33,900	99	7	Donuts	7, 21, & 35	830	2,150	2,450	530	5.0	7.5
48	27,416	"	33,200	134	7	"	"	880	2,670	2,670	610	4.3	8.9
49	27,417	"	32,800	100	2	"	"	960	2,740	5,090	440	4.7	5.5
50	27,418	"	32,400	140	2	"	"	910	2,870	2,200	740	NR	NR
51	27,419	5 Jun	38,000	103	7	"	"	680	1,890	2,160	590	3.6	6.4
52	27,420	"	37,800	138	7	"	"	550	2,140	2,230	500	4.1	8.1
53	27,421	"	37,400	101	2	"	"	580	1,820	1,780	530	3.5	6.1
54	27,422	"	36,600	138	2	"	"	450	1,840	1,750	400	4.5	7.9
55	27,434	23 Jun	37,500	122	0	Rails	7 & 21	990	4,330	10,300	1,170	9.2	12.2
56	27,435	"	36,200	121	0	"	"	890	4,580	10,360	760	9.5	13.1
57	27,436●	"	37,400	128	0	"	"	990	4,790	10,970	0	9.3	11.1
58	27,437	"	35,900	127	0	"	"	1,020	4,130	6,400	800	5.6	10.2
59	27,438	29 Jun	36,800	102	0	Donuts	"	530	1,780	4,120	360	7.1	10.2
60	27,439	"	36,100	144	2	"	7, 21, & 35	930	2,820	2,650	840	4.9	6.7
61	27,440	"	35,700	124	0	"	"	980	2,930	4,670	840	5.3	6.8
62	27,441	"	35,200	139	0	"	"	1,070	3,310	940	940	5.8	8.8
63	27,442	"	34,100	109	0	"	"	620	2,220	5,020	490	7.5	7.1
64	27,443	"	33,700	124	0	"	"	670	2,600	6,180	670	6.9	7.8
65	27,444	"	33,300	141	0	"	"	630	2,640	4,610	630	7.9	6.1
66	27,445	"	32,900	138	0	"	"	670	2,960	5,690	670	7.7	6.0
67	27,458	14 Jul	37,500	101	0	Rails	7 & 21	0	1,380	1,510	0	8.4	19.4
68	27,459	"	36,900	112	2	"	"	450	2,870	2,640	270	7.2	9.9
69	27,460	"	36,100	109	0	"	"	710	2,980	5,640	530	7.9	8.3
70	27,461	"	35,700	126	2	"	"	980	4,310	4,130	670	7.7	11.0
71	27,462	"	35,200	128	2	"	"	960	4,850	6,310	840	7.6	9.8
72	27,463	"	37,700	133	2	"	"	840	4,220	3,780	620	6.1	8.3
73	27,464	"	37,000	133	2	"	"	940	4,660	5,100	810	6.9	10.2
74	27,465	"	36,000	130	2	"	"	1,010	4,720	5,360	820	6.4	11.0
75	27,466	"	35,500	132	2	"	"	1,070	4,890	4,040	930	6.0	9.8
76	27,467	"	35,300	132	2	"	"	1,070	4,930	6,270	1,020	6.5	10.6

NR = No record; NA = Not applicable.

* Defined as: aircraft tire sections, plastic rails, rubber donuts, and no pendant supports--pendant flush on deck.
† F-4 airframe at RSTS No. 5; 6 feet of tape pulled through port M-21 tape clamp.
‡ Starboard cam released after main-wheel rollover.
◇ Afterburner power during rollover.
• Pendant moved aft on runway surface by afterburner blast; no vertical motion.
▲ Normal landing rollout; no afterburner power.
■ Port cam released.
● Port and starboard cams released.
* Starboard cam released.